J. Helminthol. Soc. Wash.
60(1), 1993, pp. 1–4

Prevalence and Intensity of *Gyrodactylus maculosi* sp. n. (Monogenea) Parasitizing Gills of Sculpin (*Oligocottus maculosus*) in Coastal British Columbia, Canada

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ABSTRACT: *Gyrodactylus maculosi* sp. n. (Monogenea: Gyrodactylidae) is described from the gills of tidepool sculpin (*Oligocottus maculosus*) in coastal British Columbia, Canada. The parasite resembles most closely *G. cranei* Mizelle and Kritsky, 1967, and *G. pacificus* Mizelle and Kritsky, 1967, described from the Pacific tomcod (*Microgadus proximus*). The 3 species appear to represent a lineage that has radiated among neritic fishes off the coast of western North America. Members have stout hamuli with a short recurved point and long recurved root and a ventral bar devoid of anterolateral processes. The marginal hook sickle has a well-developed base with a relatively slender blade. Each species has characteristic haptoral sclerites. Host fishes were collected bimonthly from January 1988 through December 1988. Prevalence was 61–100%. Intensity was 1–598, with highest numbers of parasites recovered in June and July. In spite of intense infections there was no sign of gross pathology of the gills or of host mortality.

KEY WORDS: *Gyrodactylus maculosi* sp. n., Monogenea, *Oligocottus maculosus*, British Columbia.

During a study of parasites of sculpin (*Oligocottus maculosus* Girard) inhabiting tidepools in coastal British Columbia, a previously undescribed species of *Gyrodactylus* was found. The present study describes the new worms as *Gyrodactylus maculosus* sp. n. and reports on the parasite's seasonal occurrence and effect on the host.

Materials and Methods

Semimonthly samples of 13–16 adult *O. maculosus* were collected from tidepools located around Popham Island, Howe Sound (49°21′N, 123°29′W), British Columbia, Canada, between January and December 1988. Fish were captured by dip net during low tide and fixed immediately in 10% formalin. Standard length and weight of each fish were recorded. Gills were excised and examined microscopically for parasites. Prevalence refers to the percentage of infected fish in a sample. Mean intensity refers to the mean number of parasites per infected fish. A Kolmogorov-Smirnov test statistic revealed that the intensity data were overdispersed, approaching a negative binomial distribution. We therefore applied the nonparametric Kruskall-Wallis test when comparing grouped bimonthly intensities. We also found it appropriate to calculate median intensities, so as to minimize the influence of the overdispersed data. Ten parasites were mounted unstained in glycerine jelly and used for morphological study; 6 were measured by means of an ocular graticule. Measurements of the holotype are followed in parentheses by those of the paratypes. All measurements are in micrometers.

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Results

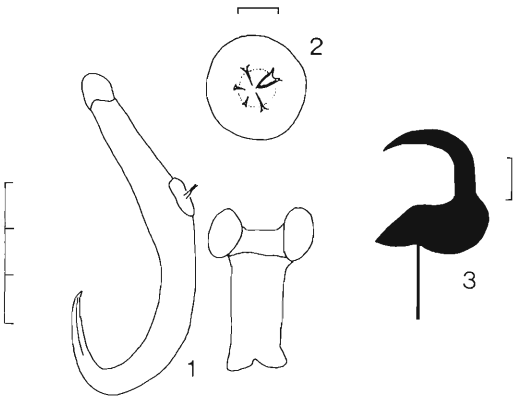
Gyrodactylus maculosi sp. n. (Figs. 1–3)

DESCRIPTION: Mounted specimens 410 (360–450) long, 100 (90–140) wide at midbody. Pharynx 40 (39–42) long, with long cellular processes. Penis (12–15) in diameter, with a single large spine and 2 pairs of small spines in single row at opening of ejaculatory duct. Hamuli robust, 67 (63–67) long; root 31 (29–31), shaft 44 (42–44), point 22 (20–23). Ventral bar dumb-bell shaped, 31 (21–25) wide, 7 (5–7) long medially. Ventral bar anterolateral processes absent. Ventral bar membrane rectangular in shape, 25 (21–25) long with posterior margin indistinct. Dorsal bar simple, without median notch. Marginal hook 36 (33–36) long. Marginal hook sickle 6 (6–7) long, 4 (4–6) wide basally, 7 (6–7) wide distally, with strongly recurved blade. Marginal hook handle consistent width along entire length and without distinct terminal swelling, 30 (30–31) long. Filament 9 (9–11) long.

TYPE HOST: *Oligocottus maculosus* Girard (adults).

TYPE LOCALITY: Popham Island, Howe Sound (49°21′N, 123°29′W), British Columbia, Canada.

SPECIMENS STUDIED: Detailed measurements were obtained from 6 specimens. The holotype (no. 82429) and 2 paratypes (no. 82430) are deposited in the USNM Helminthological Collection, Beltsville, Maryland.



Figures 1–3. Sclerites and penis of *Gyrodactylus maculosi* parasitic on the gills of *Oligocottus maculosus*. 1. Hamulus and ventral bar. Scale = 30 μm. 2. Penis. Scale = 6 μm. 3. Marginal hook sickle. Scale = 2 μm.

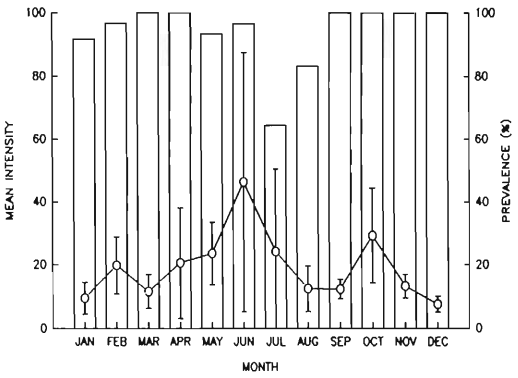


Figure 4. Changes in prevalence (histogram) and mean intensity (line graph) of *Gyrodactylus maculosi* on gills of *Oligocottus maculosus* throughout 1988. Error bars represent 95% confidence limits.

Prevalence and intensity of infection

Gyrodactylus maculosi was common on *O. maculosus* in the tidepools. Prevalence of infection was 90% or higher during all months of the year except July and August (Fig. 4). During July and August it was 61 and 82%, respectively (Fig. 4). Intensity ranged from 1 to 598. Statistical comparison of monthly intensities revealed significant seasonal changes ($P < 0.05$), with a recorded high during June 1988. The decline in prevalence during July and August corresponded with a significant ($P < 0.05$) seasonal decrease in intensity during the same period (Fig. 4).

Pathology of infection

There was no evidence of host mortality within the tidepools. Gills of infected fish appeared normal and showed no obvious gross pathology when viewed with a stereomicroscope. Intensity of infection did not correlate ($P < 0.05$) with host condition factor (weight (mg)/length (mm)^3). Intensity increased significantly with host size. A "box and whisker" plot of median intensity serves to illustrate the latter relationship by minimizing the effects of extreme values (Fig. 5).

Ecology of the host population

The sculpin collected were fish that had remained in the tidepools after tidal retreat. From January to June, samples included fish of similar length classes (Fig. 6). However, during the months of July and August, the lengths of fish sampled decreased (Fig. 6). Similarly, samples collected during November and December represented increasingly smaller fish (Fig. 6).

Discussion

Gyrodactylus maculosi resembles *G. cranei* Mizelle and Kritsky, 1967, and *G. pacificus* Mizelle and Kritsky, 1967, both species being described from tomcod (*Microgadus proximus*) inhabiting coastal waters of California (Mizelle and Kritsky, 1967). All 3 species have characteristically stout hamuli with a long recurved root and a short recurved point. The ventral bar does not have anterolateral processes and the marginal hook has a well-developed base and relatively thin blade. The 3 species likely represent a lineage that has radiated on neritic fishes of coastal waters of western North America. Similar species of *Gyrodactylus* are not known from other regions of the world. Cottid fishes from coastal regions of eastern North America historically acquired members of an entirely separate lineage of gyrodactylids involving the *groenlandicus* species group (Cone and Wiles, 1983).

The 3 species are easily identified: *Gyrodactylus maculosi* has a hamulus point that curves consistently at its base, the dorsal bar is a simple tube that inserts centrally onto the hamulus knob, the ventral bar membrane is almost rectangular, and the handle of the marginal hook has a consistent width along its length; *Gyrodactylus cranei* has a distinct angle formed at the base of the hamulus point, the dorsal bar wraps around the hamulus knob, the posterior membrane is expanded distally, and the marginal hook handle has a terminal swelling (Crane and Mizelle, 1967);

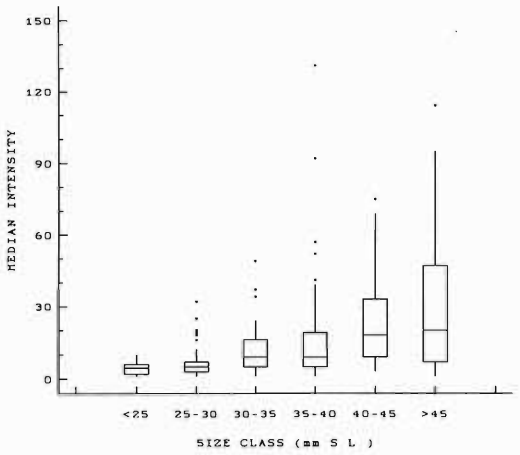


Figure 5. "Box and whisker plot" of median intensities of *Gyrodactylus maculosi* in different size classes of *Oligocottus maculosus*. The plot graphically represents a summary of data where the central line (horizontal) is the median, the box covers the middle 50% of the data between the upper and lower quartiles, the whiskers extend out to extreme values within 1.5 times the interquartile, and the points beyond the whiskers are outliers. Four omitted data points include 220, 260, 598 (35–40-mm size class), and 300 (>45-mm size class).

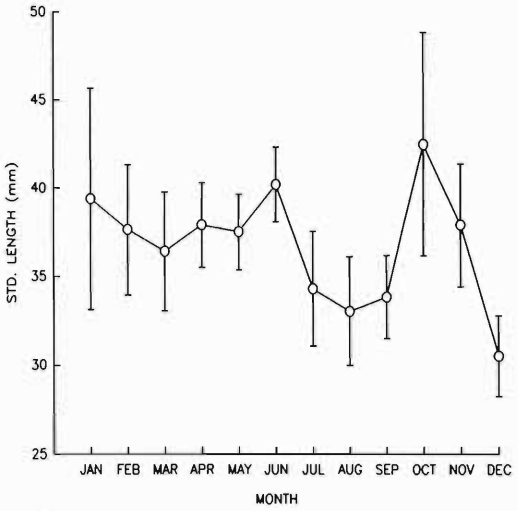


Figure 6. Mean standard length of *Oligocottus maculosus* collected from tidepools of Popham Island, Howe Sound, British Columbia, during 1988.

Gyrodactylus pacificus has relatively long hamuli (81–91 μm) and the dorsal bar is bifurcate terminally (Crane and Mizelle, 1967).

Gyrodactylus maculosi is the third species of the genus to be described from cottid fishes of the northeastern Pacific Ocean. The others include 2 species from *Leptocottus armatus* (*G. armatus* Crane and Mizelle, 1967, and *G. sculpinus* Crane and Mizelle, 1967). Neither species resembles *G. maculosus* and both normally occur on the body surface. The report (Arai, 1969) of an unidentified gyrodactylid from *O. maculosus* was likely *G. maculosi.*

Observed intensity of *G. maculosi* on *O. maculosus* is high compared to other gyrodactylids on neritic marine fishes. Kamiso and Olson (1986) observed 1–49 *Gyrodactylus stellatus* on the body of young sole (*Parophrys vetulus*) collected in Yaquina Bay, Oregon. One obvious cause for the difference is that extended aggregation of *O. maculosus* in shallow tidepools likely facilitates transmission of viviparous monogeneans. Petrushevski and Shulman (1958) also reported intense infections of *Gyrodactylus arcuatus* on sticklebacks stranded in tidepools of the White Sea. Intensities of up to 1,000 reportedly contributed to significant host mortality. In the present study we found no evidence to suggest that *G. maculosi* causes host death. In fact, our analysis failed to find any significant relationship between intensity and host condition factor, suggesting a stable host–parasite relationship even under crowded conditions of the tidepools.

Eggs of *O. maculosus* are laid late in October to late April and hatch from February to May; settlement of the larvae (10+ mm) occurs from March through the end of May and early June. Juveniles are 25–30 mm long when they are first seen in the tidepools (Craik, 1978). Our observations indicate that juvenile sculpins obtained infections shortly after establishment in the pools, presumably after contact with older, infected fishes.

The seasonal change in prevalence and intensity of *G. maculosi* near Popham Island is similar in certain respects to that reported for *G. stellatus* on *P. vetulus* in coastal Oregon (Kamiso and Olson, 1986). Young *P. vetulus* acquire infections soon after entering the estuary in spring and, by June, prevalence and intensity reach a seasonal high (98% and 10, respectively). Prevalence and intensity decreased gradually to a low in October when fish were leaving the estuary. With *G. maculosi* there is a gradual increase in intensity of infection from January to June, during the months in which we consistently sampled cohorts with a mean length of 36–40 mm. The intensity data also revealed a late summer and early winter

decline in the numbers of parasites similar to that reported for *G. stellatus* on *P. vestulus*. However, since intensity increased with host size, the observed fall oscillation in intensity is likely exaggerated because small fish were sampled. Low intensities found on the fish during the January 1988 samples suggest that a winter decline in parasite populations occurs.

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Obituary Notice

GILBERT FRED OTTO

16 December 1901 - 17 November 1992

Elected Member - 17 September 1927
President - 1936
Editor - 1952-1965
Editorial Board 1934-1976; 1980-1992
Anniversary Award - 1965
Life Member - 1972
Special Service Award - 1980